

Amendments to the Specification:

A second Substitute Specification together with a marked-up copy are appended hereto.

No new matter has been added to the appended second Substitute Specification.

SECOND SUBSTITUTE SPECIFICATION OF PCT/NL00/00313

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Title: AN UNMANNED VEHICLE FOR DISPLACING MANURE

RELATED APPLICATION:

This Application is a Continuation Application of International Application No. PCT/NL00/00313, filed May 10, 2000.

FIELD OF THE INVENTION:

This invention relates to an unmanned vehicle for displacing manure.

BACKGROUND OF THE INVENTION:

Modern stables have a stable floor which is provided with apertures that receive through them cow manure. A receptacle is provided under the stable floor in which manure that passed therethrough is collected. Generally there is also provided in the stable a so-called manure slide which moves through the stable at predetermined times and displaces the manure partially to the dung pit and partially through the apertures in the stable floor.

A new development is an unmanned vehicle for displacing manure. Such a vehicle is known from, for example, Messrs. Joz B.V. as the JOZTECH (Landbouw Rai (Agricultural Rai), Amsterdam, January 1999). This vehicle is provided with a propelling unit comprising two freely rotatable wheels and one driven and controllable wheel. The disadvantage of said vehicle is that the construction of the driven and controllable wheel is complicated and therefore expensive. Moreover, the vehicle is very sensitive to dirt, which is not desirable in an environment such as a stable. Furthermore, the JOZTECH is driven by only one controllable wheel, whereby wheel skidding often occurs on the stable floor which is very slippery due to the

presence of manure. As a result thereof it is not possible to determine the exact position of the vehicle on the basis of the number of revolutions of the driven wheel. Finally, the manure slide exerts relatively little pressure on the stable floor so that not all the manure is displaced by the manure slide and part of the manure moves under the lower side thereof.

SUMMARY OF THE INVENTION:

An object of the invention is to obviate the above-mentioned drawbacks by fitting the manure displacement means to the unmanned vehicle so it is indispensable for supporting or propelling the vehicle or both. The invention further relates to an unmanned vehicle wherein its steering comprises a propelling unit that includes at least one propelling member. The advantage of this unmanned vehicle is that the manure displacement means forms part of the supporting means, as a result of which a considerable part of the weight of the unmanned vehicle always bears on the manure displacement means, whereby sufficient pressure always bears against the stable floor, whereupon the manure is effectively displaced over the stable floor and is received through the apertures in a stable floor. Moreover, the drive unit of the propelling members also constitutes the steering unit of the unmanned vehicle. Accordingly, a compact construction is achieved which is insensitive to dirt and which, in addition, is less complicated thus reducing manufacturing costs.

According to an inventive feature, the unmanned vehicle comprises a steering unit which is constituted by the propelling unit which comprises at least one rotatable propelling member. In this manner a particularly compact vehicle is provided which has excellent maneuverability. According to another embodiment of the invention, the vehicle comprises a steering unit which is constituted by the propelling unit which comprises at least two independently driven

propelling members. In this embodiment maneuverability of the vehicle is possible by varying the peripheral velocities of the propelling members. The propelling members may comprise a wheel or a caterpillar track or both. Caterpillar tracks have the advantage of being less sensitive to skidding than wheels.

In accordance with another inventive feature, the unmanned vehicle is equipped with orientation means for following a path in a space for determining the position of the vehicle in a space, such as a stable or a meadow. The orientation means comprise floor detection means for detecting apertures in the floor or detecting a guidance means in the floor, such as the reinforcement in the concrete or an electricity conducting wire or a combination thereof. The apertures in the floor are usually provided for removing the manure as described above. When the stable floor is made of concrete, there is usually a metal grid in the floor to give it extra strength. Said grid can be detected by means of the floor detection means with the aid of, for example, an induction coil. Additional orientation means may comprise a compass or a gyroscope or an air level or a clinometer or an accelerometer, or a combination thereof. These orientation means are currently available in a form which is suitable for being applied in electronic circuits, so that integrated orientation means can easily be assembled from the various components.

Besides, the orientation means also comprises wall following means for detecting and following a wall, such as a fixed stable wall or the edge of a cubicle. These wall following means extend over at least part of the circumference of the unmanned vehicle. The wall following means may also be disposed on the manure displacing means. In a preferred embodiment, the wall following means consists of a freely rotating substantially round element, such as preferably a wheel or a disc or a sphere or a combination thereof.

Furthermore, the invention relates to an unmanned vehicle which is equipped with orientation means for following a path in a space or determining a position of the vehicle in a space, such as a stable or a meadow. It will be appreciated, moreover, that the unmanned vehicle is not only capable of being used for displacing manure, but also for other activities, such as spreading material, such as sawdust and straw, determining and controlling the climate in the stable, and determining the behavior and health of the animals. For that purpose the unmanned vehicle is equipped with orientation means comprising floor detection means for detecting apertures in the floor or detecting a guidance means in the floor, such as the reinforcement in the concrete or an electricity conducting wire or for detecting a combination thereof. Moreover, the orientation means may also comprise a compass or a gyroscope or an air level or a clinometer or an accelerometer or a combination thereof. The orientation means may also comprise wall following means for detecting and following a wall, such as a fixed stable wall or the edge of a cubicle. The wall following means extend preferably over at least part of the circumference of the unmanned vehicle. The wall following means may also be disposed on the manure displacement means. The wall following means may consist of a freely rotating, substantially round element. The round element is preferably constituted by a wheel or a disc or a sphere or a combination thereof.

According to another inventive feature, the unmanned vehicle is equipped with protective facilities for protecting the vehicle from colliding with obstacle, such as the legs of cows, or fixed objects, such as supporting pillars in the stable.

The protective facilities may comprise a bumper or a sensor for detecting cows, or both. The protective facilities may also comprise wall following means or positioning means for determining the position of an obstacle relative to the unmanned vehicle. The positioning means

may comprise a clinometer or an accelerometer or both. The positioning means are preferably disposed on the wall following means. In this manner it is possible to determine the angular deflection and angular acceleration of, for example, the wall following means, so that information is obtained regarding the position of the obstacle. The signal from the positioning means is used for actuating the steering unit.

The manure displacement means preferably comprises at least one brush or at least one manure slide or at least one spraying unit or a combination thereof.

In accordance with a yet further inventive feature, the unmanned vehicle is equipped with anti-bumping means for preventing the manure displacement means from moving too far away from the floor. The anti-bumping means comprises a bumper or a bracket or both. The anti-bumping means preferably comprises an anti-bumping sensor for detecting the movement of the manure displacement means relative to the floor, which anti-bumping sensor is coupled to the propelling unit. Such anti-bumping sensor may consist of a switch which is disposed on the bumper or bracket. When the manure slide moves too far away from the stable floor, the switch touches the stable floor, whereupon the unmanned vehicle is caused to move in an opposite direction until all its supporting means bear on the stable floor.

BRIEF DESCRIPTION OF THE DRAWINGS:

The invention will now be explained in further detail with reference for the accompanying drawings.

Figure 1 is a plan view of the unmanned vehicle comprising one rotatable propelling member;

Figure 2 is a side elevational view of the unmanned vehicle of Figure 1 that comprises one rotatable propelling member;

Figure 3 is a plan view of the unmanned vehicle comprising two independently driven propelling members;

Figure 4 is a side elevational view of the unmanned vehicle of Figure 3 that comprises two independently driven propelling members; and

Figure 5 is a view similar to Figure 2 to indicate the presence of components described herein but not otherwise shown in the drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

The unmanned vehicle as shown in Figures 1 and 2 consists of a frame 1 which is provided with a propelling unit 2 and a scraper or manure slide 3. The steering unit of the unmanned vehicle is constituted by propelling unit 2, which propelling unit 2 comprises a rotatable wheel 4. As shown in the drawings, a particularly compact vehicle is provided which has moreover an excellent maneuverability. On frame 1 are also disposed a wall following means 5 which, in this embodiment, comprises a wheel 9 which is freely rotatable about a vertical axle 8.

When operating, the vehicle is propelled by wheel 4. When wall following means 5 touches an obstacle, such as a cow's leg, this results in a resultant force on the vehicle, which causes the vehicle to travel around the obstacle. Wall following means 5 may also be used for following a wall. In that case the vehicle is constantly caused to travel a direction towards the wall. Subsequently there is exerted by the wall a reactive force on the wall following means in

the direction away from the wall. As a result thereof the vehicle travels in a straight line along the wall, while wall following means 5 remains in contact with the wall.

Figures 3 and 4 show another embodiment of its unmanned vehicle, in which parts corresponding to those of the first embodiment are indicated by the same reference numerals. The vehicle is furthermore provided with a bracket or bumper 6 which not only protects the vehicle against obstacles, but also ensures that scraper or manure slide 3 does not move too far away from the stable floor. The anti-bumping sensor 7 is disposed on bracket or bumper 6 for detecting movements during which the manure slide moves away from the stable floor.

The way of moving and functioning of wall following means 5 is identical to that described with reference to the embodiment shown in Figures 1 and 2. Maneuvering the vehicle is possible by varying the drive torque or the peripheral velocity of wheels 4. When the anti-bumping sensor 7 detects that the scraper or manure slide 3 has moved away from the underlying surface (which, if concrete, will contain reinforcement rods that function as guidance means for orientation means in the vehicle), the unmanned vehicle is caused to move in an opposite direction. In practice the anti-bumping sensor 7 may be constituted by a switch which is connected to propelling unit 2 so that the propelling unit causes the vehicle to move in an opposite direction in order to prevent the vehicle from bumping.

Figure 5 is similar to Figure 2, but includes components that although described herein, are not otherwise indicated in the drawings. Here propelling unit 2 comprises caterpillar tracks 4. Instead of a scraper or manure slide 3, a brush 8 is provided which may also represent a spraying unit. Wall following means 5 comprises a disc 9. An orientation and positioning means 10 may be associated with the vehicle in any manner considered appropriate and correct

by one skilled. It consists of a gyroscope, accelerometer, compass, air level device, clinometer, a sensor for detecting cows, or any combination thereof.

Although I have disclosed the preferred embodiments of my invention, it is to be understood that it is capable of other adaptations and modifications within the scope of the appended claims.